POTASSIUM ENHANCES THIGMOTROPICALLY STIMULATED APPRESSORIUM FORMATION IN *COLLETOTRICHUM CAPSICI*

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ABSTRACT - Thigmotropically induced appressoria of the anthracnose fungus *Colletotrichum capsici* was enhanced by K + in the medium. Influx of K + appears to be essential for germ tube differentiation of this fungus.

RÉSUMÉ - Amplification par le potassium de l'induction thigmotropique des appressoria de *Colletotrichum capsici*. Le potassium semble essentiel à la différenciation du tube germinatif de ce champignon.

KEY WORDS : *Colletotrichum capsici*, appressorium, thigmotropic stimulus, anthracnose fungus.

INTRODUCTION

The conidium of anthracnose fungi, upon germination, differentiates to produce a specialized infection structure called the appressorium. The appressorium attaches the pathogen to the host surface and also assists in penetrating the epidermal tissue of the host. Although some physical and chemical factors are known to influence appressorium formation in anthracnose fungi (Staples & Macko, 1980; Wolkow et al., 1983; Muruganandam et al., 1987), the actual mechanism of induction of this structure is little understood (Staples & Hoch, 1987). We report here the effect of some ions on appressorium formation in *Colletotrichum capsici*.

MATERIALS AND METHODS

A single conidium isolate of *Colletotrichum capsici* (Syd.) Butler & Bisby which causes fruit rot of chilli was used. The fungus was grown on a disk of cellophane overlying Czapek-Dox agar medium (pH 6.5) as this condition induced maximum conidiation (Suryanarayanan et al., 1982). The conidia were collected in sterile distilled water and this suspension was filtered through sterile cotton to get a mycelium-free suspension. The concentration

of the conidia in the suspension was adjusted to 1.1 x 10^5/ml. About 0.1ml of this suspension was spread on water agar containing 0, 0.03, 0.06, 0.12, 0.25, 0.50 or 1.0 M of KCl, KH_2PO_4, KNO_3, NaCl, $CaCl_2$, $MgCl_2$ or $BaCl_2$ and incubated at 30 ± 1°C for 18h. The pH of the medium was adjusted to 6.5 before autoclaving. The conidia were observed under the high power field (x 450) of a compound microscope and the germinated conidia were scored for calculating the percentage of appressorium formation. Nine different areas in each of the 3 petri dishes for each treatment were observed for calculating the results. The conidial suspension was also spread on a sterile disk of cellophane overlying water agar with different concentrations of these salts. Clear, transparent and uncoated cellophane was used.

RESULTS AND DISCUSSION

Appressoria were not produced by conidia germinated on medium which contained 2% agar irrespective of the nature and concentration of salt despite many attempts to do so. This result is compatible with the findings of Miehle & Lukezic (1972), Mercer et al. (1975) and Staples et al. (1976). They showed that the conidia of different species of *Colletotrichum* fail to produce appressoria on soft surfaces such as agar but readily produce them when the germ tubes contact hard surfaces. In addition, Pavgi & Dickson (1961) and Parbery (1981) have reported that cellophane favours formation of more appressoria than agar for many fungi. While these studies revealed that a thigmotropic stimulus is the primary determinant in the germ tube differentiation, we now report that the presence of salts in the cellophane-overlying medium also influenced the formation of appressoria in *C. capsici* (Tab. 1, 2). An interesting observation is that potassium salts at 0.06M induced maximum number of appressoria (Tab. 1). The above effect of potassium salts could be attributed to the nature of the ions rather than osmotic as salts other than potassium, at the same concentration, reduced the number of appressoria or even inhibited germination of conidia at higher concentration (Tab. 2). In addition, it is the K^+ but not anion of potassium

Table 1 - Effect of different concentration of KCl, KH_2PO_4 and KNO_3 on appressorium formation in *C. capsici*.
Tableau 1 - Effet de différentes concentrations de KCl, KH_2PO_4 et KNO_3 sur la formation des appressoria chez *C. capsici*.

	% of conidia forming appressoria on cellophane		
Concentration of salt (M)	KCl	KH_2PO_4	KNO_3
0.00	17.1±2.0	18.5±1.8	21.7±1.8
0.03	18.1±1.8	47.8±2.6	40.9±2.0
0.06	46.3±1.6	85.1±3.6	62.0±4.0
0.12	35.7±2.6	30.7±2.4	34.6±1.6
0.25	11.7±2.6	28.1±1.6	29.7±1.0
0.50	10.0±1.4	17.8±2.6	4.0±1.2
1.00	nil	nil	nil

salts that was responsible for the induction. This is evident from the fact that potassium salts with different anions (Cl, PO_4, NO_3) induced appressoria to the same extent. Further more, appressorium formation increased with increasing concentration of K+ up to 0.06M (Tab. 1).

Uptake of cation by a fungal cell is known to be affected by the presence of other cations or H+ outside the cell (Armstrong & Rothstein, 1969; Jennings, 1979). In the present study, it was observed that when K+ was supplied along with Na+, there was considerable decerase in the number of appressoria formed; the number of appressoria decreased with increasing concentration of Na+ (Tab. 3). In addition, the effect of K+ was influenced by the pH of the medium on which the conidia germinated (Tab. 4). These results clearly indicate that an influx of K+ is essential for germ tube differentiation in *C. capsici*. However, the ion effect was observed only when a contact stimulus (cellophane) was also provided. Thus, the results enable us to speculate the importance of ions of host exudate and the nature of host surface in the penetration process of anthracnose fungi. It is perti-

Table 2 - Effect of different concentrations of NaCl, $CaCl_2$, $MgCl_2$ and $BaCl_2$ on appressorium formation in *C. capsici*.
Tableau 2 - Effet de différentes concentrations de NaCl, $CaCl_2$, $MgCl_2$ et $BaCl_2$ sur la formation des appressoria chez *C. capsici*.

	% of conidia forming appressoria on cellophane			
Concentration of salt (M)	NaCl	$CaCl_2$	$MgCl_2$	$BaCl_2$
0.00	20.0±2.6	18.7±2.4	18.5±1.8	18.5±2.6
0.03	10.5±1.6	8.8±1.2	8.3±1.6	nil
0.06	3.5±1.8	2.8±1.2	12.1±2.2	nil
0.12	9.3±2.7	7.3±2.4	3.0±1.0	nil
0.25	2.7±1.6	nil	3.2±1.2	nil
0.50	nil	nil	2.6±1.0	nil
1.00	nil	-	-	-

Table 3 - Combined effect of KCl and NaCl on appressorium formation in *C. capsici*.
Tableau 3 - Effet combiné du KCl et du NaCl sur la formation des appressoria chez *C. capsici*.

Medium composition (M) KCl	Medium composition (M) NaCl	% of conidia forming appressoria on cellophane
0.00	0.00	20.0±0.4
0.06	0.00	44.1±0.9
0.00	0.06	9.6±1.2
0.06	0.06	17.6±0.5
0.06	0.12	13.9±0.8

Table 4 - Effete of pH on induction by KCl (0.06 M) of appressorium formation in *C. capsici*.
Tableau 4 - Effet du pH sur l'induction par le KCl 0.06 M des appressoria chez *C. capsici*.

pH	% of conidia forming appressoria on cellophane
3.0	3.1±0.9
4.0	3.3±1.2
5.0	34.4±0.7
6.0	43.4±1.2
7.0	20.6±0.4
8.0	22.2±0.7
9.0	8.6±1.6
10.0	7.4±2.4

nent to mention here that Kaminskyj & Day (1984) have reported K+-induced appressorium formation in rust fungi which are obligate parasites. However, appressorium formation in anthracnose fungi as stimulated by K+ has not been reported previously.

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